Innovation

Our Research & Development

R&D as a future growth engine

A world-class R&D organization is the centerpiece of our innovation efforts. The accumulated expertise and resulting IP are among our company's most valuable assets.

To maintain our competitive edge as a leading global chemical company, we conduct R&D for near-term business impact, while at the same time creating new pillars to support our long-term growth. In addition to in-house R&D, we fully leverage open innovation to increase our speed to market through collaboration with government, academia, startups, and corporate partners.

Driving near-term business impact

Ultra-low dielectric loss film—Contributing to the realization of "Beyond 5G"

For next-generation telecom systems, it is critical to reduce transmission loss, particularly in high-frequency applications. We have developed a new class of films with high dielectric properties that leverage our unique material design and synthesis technology to reduce the loss tangent*1 to less than 0.001. This film reduces transmission loss in the 5G millimeter wave band (28 GHz) by about 50% compared to conventional products, while also providing high transparency, heat resistance, and excellent copper adhesion.

*1 A numeric value that expresses the degree of electrical energy loss in a dielectric

Green KTF and BioPTMG*2—Targeting carbon neutrality through bio-based high-performance products

To meet increasing demand for KTF, our moisture transmission film product, but at the same time to reduce CO_2 emissions during production by 30%, we have launched Green KTF. Green KTF is derived from natural products such as calcium carbonate and plant-derived polyethylene, yet it maintains the same performance as conventional KTF. Main applications include back sheets of disposable diapers and high-performance protective clothing. We have taken a similar approach to our PTMG product, which is used as a raw material for polyurethane and polyester resins. We have developed BioPTMG, which boasts the same performance as petroleum-derived PTMG, while dramatically reducing associated CO_2 emissions.

Low-temperature nitridation technology

Hydrazine is attractive to the semiconductor industry as a potential low-temperature nitrogen source precursor in atomic layer deposition (ALD) of metal nitride thin films. However, because of its high reactivity, safe handling of hydrazine is challenging. We are developing low-temperature nitridation technology for high-purity hydrazine and the associated bulk delivery system, which will improve the ALD process throughput and the quality of nitride thin films.

*2 Poly tetramethylene ether glycol

Creating the next pillars of growth

Focus on precision medicines

We aim to realize precision medicine that takes into account the causes and phenotypes of diseases in the central nervous system and immuno-inflammation. Our precision medicine approach provides appropriate healthcare to patients at appropriate times, considering the differences in people's genes, environment, and lifestyles. MT-7117, currently under development for erythropoietic protoporphyria and systemic sclerosis, is our leading precision medicine program.

We are promoting digital technologies to realize precision medicine. For example, we are collaborating with academia and AI venture companies to develop AI technology for drug screening. This technology enables accelerated drug evaluation using large-scale image data, instead of time-consuming data review by highly skilled researchers. We anticipate applying this technology in the future to drug screening based on genetic polymorphism and drug screening using human induced pluripotent stem (iPS) cells from patients.

Plant-based growth factors for regenerative medicine

Cell culture materials are critical in regenerative medicines for cultivating stem cells from patients or donors, enabling cell proliferation and differentiation into target organs and tissues. We are conducting research in collaboration with Myoridge Co., Ltd. (▶ Page 43) on production of growth factors using plants. This partnership leverages the process we used to create the world's first plant-based COVID vaccine, which is under development by our Canadian subsidiary Medicago, Inc. We aim to address long-standing challenges in conventional cell culture resulting from the widespread use of bovine fetal serum, including unstable supply, contamination risk, and animal welfare.

Innovation

Our Research & Development

Growth of 4-inch GaN crystal for manufacturing GaN substrates

We are collaborating with Japan Steel Works, Ltd. to improve the manufacturability of large-diameter bulk gallium nitride (GaN) substrates for power electronics with support from the New Energy and Industrial Technology Development Organization (NEDO). We have conducted crystal growth experiments for the mass production of high-quality 4-inch GaN substrates using a low-cost manufacturing technology, and have confirmed that the crystals are growing as anticipated.

External partnerships with government and academia

ARPChem and Mitsubishi Gas Chemical—Photocatalysts for artificial photosynthesis

Artificial photosynthesis is a groundbreaking technology that aims to enable a carbon-neutral society by using CO_2 as a raw material. In a major Green Innovation project funded by NEDO, we are collaborating with ARPChem and Mitsubishi Gas Chemical to develop photocatalysts with high conversion efficiency and reduced hydrogen production costs. We are also developing complementary technologies to produce high yields of basic chemical derivatives such as ethylene and propylene from hydrogen and CO_2 via alcohols.

University of California, Santa Barbara—The Mitsubishi Chemical Center for Advanced Materials

The Mitsubishi Chemical Center for Advanced Materials (MC-CAM) is an interdisciplinary materials research center at the University of California, Santa Barbara (UCSB). This partnership, started in 2001, specifically targets functional soft materials and has resulted in over 180 peer-reviewed publications to date. For example, MC-CAM has produced key advances in solid polymer electrolytes (SPE) for solid-state batteries and organic photodetector (OPD) materials. Current MC-CAM research focuses on high-value-added advanced functional materials supporting the long-term vision of the Mitsubishi Chemical Group.

What are the MOT indices?

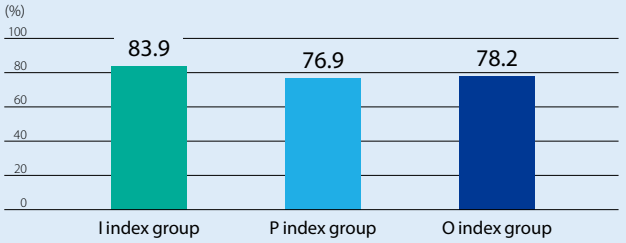
The MOT indices are one of the three axes of KAITEKI Management (MOE, MOT, and MOS) and serve as a metric for our technological and innovative capabilities. The MOT indices consist of the following three index groups, which classify the innovation process into input (I), process (P), and output (O). MOT indices are designed to focus on objectively measurable quantities, which can be compared meaningfully to competitors and to our own historical performance.

Index name	Example of measurement object
I index group	Investment in innovation activities
P index group	Progress of key R&D themes and DX
O index group	Sales of new products, number of patent applications, and quality of patents

Fiscal 2021 MOT result

The 2021 MOT indices indicate that all three groups achieved results of approximately 80%. Detailed results from the P index group suggest that we should accelerate progress in our digital capability. The O index group results reflect a need to emphasize the quality of our patents in addition to quantity. The insights derived from MOT drive us to further improve our innovative capabilities in line with our new business strategy.

Fiscal 2021 MOT results



Innovation

Our Research & Development

Finding solutions for a sustainable future

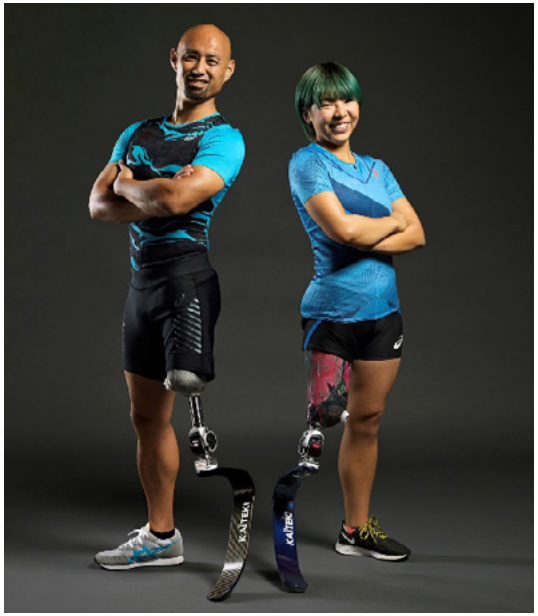
The KAITEKI Institute

The KAITEKI Institute, Inc. (TKI) was established in 2009 to act as a think tank to focus on long-term trends and opportunities. TKI does this by envisioning future market needs and prototyping conceptual products to meet those needs in collaboration with our global network of academic and scientific experts.

For example, TKI led development of a highly engineered prosthetic blade that has been used in Paralympic competition.

Another conceptual product is the "ICT Medical logistics box," an Internet of Things (IoT)-enabled box for transporting and tracking sensitive items. Mitsubishi Chemical Logistics Corporation (MCLC) is developing a portable version of the TKI concept to explore a new business model in the ethical pharmatheuticals distribution market.

TKI is now focused on efforts that align with the Group's need for an objective long-term perspective on global future scenarios and the resulting impact on new business opportunities.



Highly engineered prosthetic blade prototypes developed by TKI support Paralympic athletes in training and worldwide competitions.

Development of regenerative medicine using Muse cells

Muse cells (Multi-lineage differentiating stress enduring cells) are endogenous pluripotent stem cells naturally present in the bone marrow, peripheral blood, and connective tissues of all body organs. Muse cells can be injected intravenously and there is evidence they can migrate to injured organs, spontaneously differentiating into cells that correspond to the injured tissues.

We are developing a regenerative medicine product that exploits the special properties of Muse cells. We have been conducting clinical trials for six indications following successful non-clinical research results. We are focusing our current efforts on one principal indication, cerebral infarction (CI). In fiscal 2021, our exploratory study showed good safety properties and suggested possible efficacy. After discussions with the Pharmaceutical and Medical Devices Agency (PMDA), we are pursuing steps to secure full approval. Large-scale confirmatory clinical trials will be started in fiscal 2022 for regulatory submission.